A large-scale OH maser filament in W3(OH)

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Talk Outline

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- OH maser co-propagation
- The star-forming region W3(OH)
- MERLIN observations
- Results for W3(OH)
- Discussion of large-scale OH filament
- Summary

Project Background

A multi-frequency survey of OH masers in regions of massive star formation

Aim:

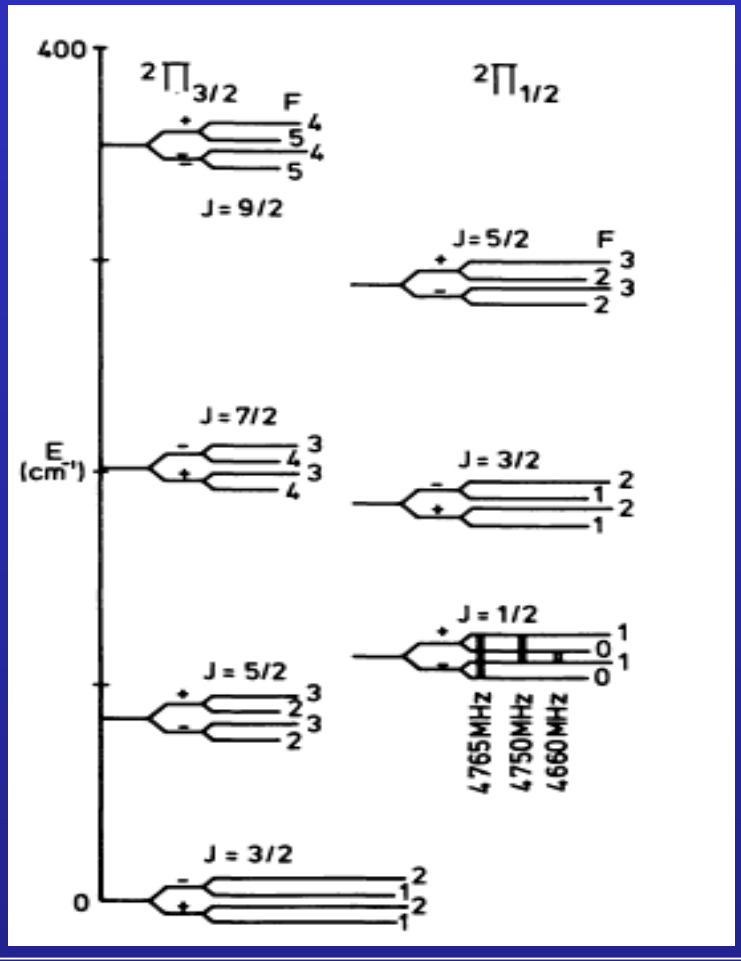
- To understand the physical conditions in ultra-compact HII regions where massive stars are forming.
- To test maser pumping models in massive star-forming regions.

Method:

- Obtain phase-referenced MERLIN images of OH masers in regions of high-mass star formation.
- Compare maser spot positions to ~10 mas in order to find co-propagating gain media.

OH maser co-propagation

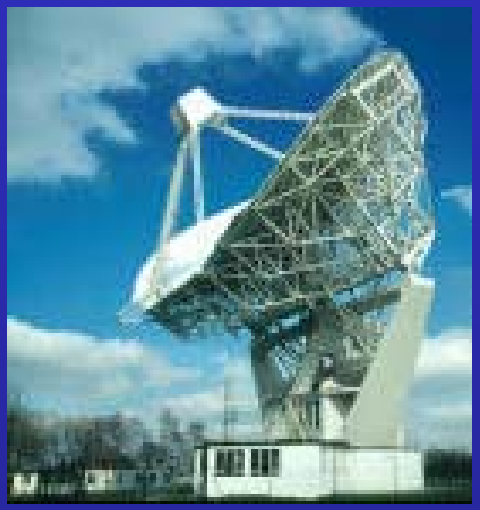
- Physical conditions in maser gain media can be extrapolated from the measured properties of masers.
- By comparing maser positions in the different transitions, models of maser pumping can be tested.
- Close (~10mas) coincidence indicates overlapping gain media and therefore a shared excitation process.



W3(OH)

- W3(OH) is the richest and most studied SFR in our Galaxy.
- It contains emission and/or absorption from every OH transition ever observed in space.
- It also contains bright H_2O and CH_3OH masers, allowing multi-frequency comparisons of OH maser positions.
- This can tell us the conditions required to produce masers in different chemical species.

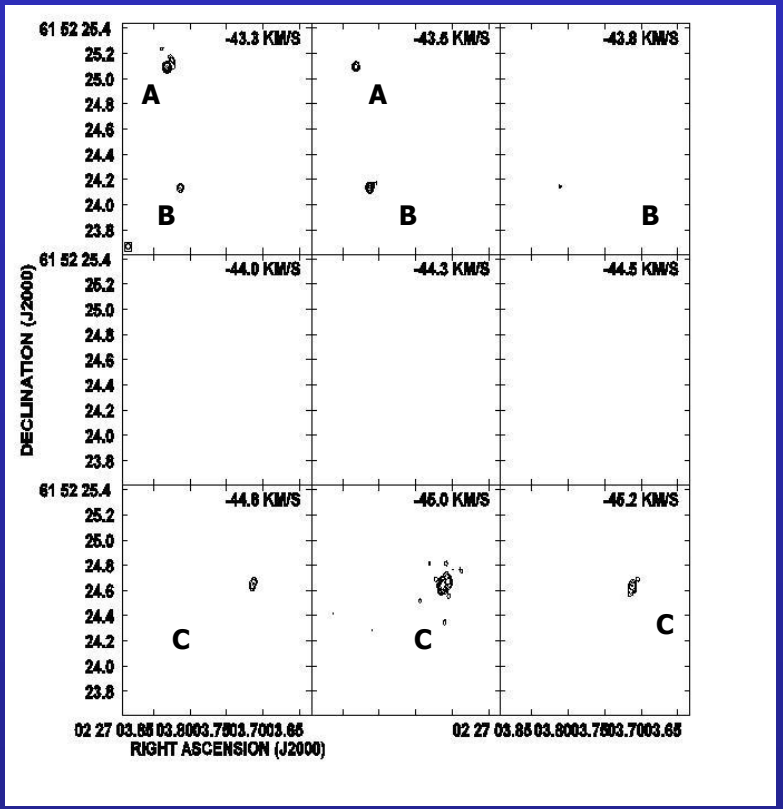
MERLIN Observations



MERLIN

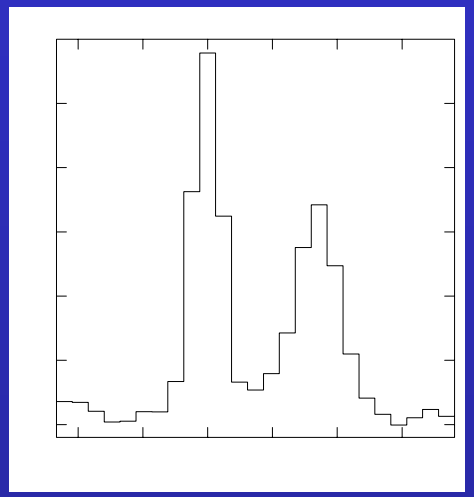
MERLIN Results

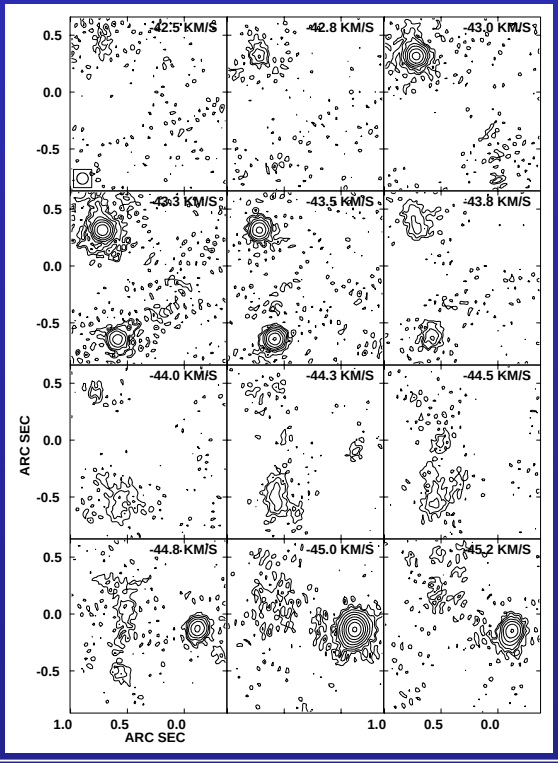
- We observed W3(OH) in the $^2\Pi_{1/2}$ J=½ lines at 4765, 4750 and 4660 MHz with phase-referencing using MERLIN and produced maps using a 50 × 50 mas synthesised beam.
- We detected the OH 4765-MHz maser spots A, B and C (Baudry et al. 1988; Gray et al. 2001; Palmer et al. 2003)



MERLIN Results

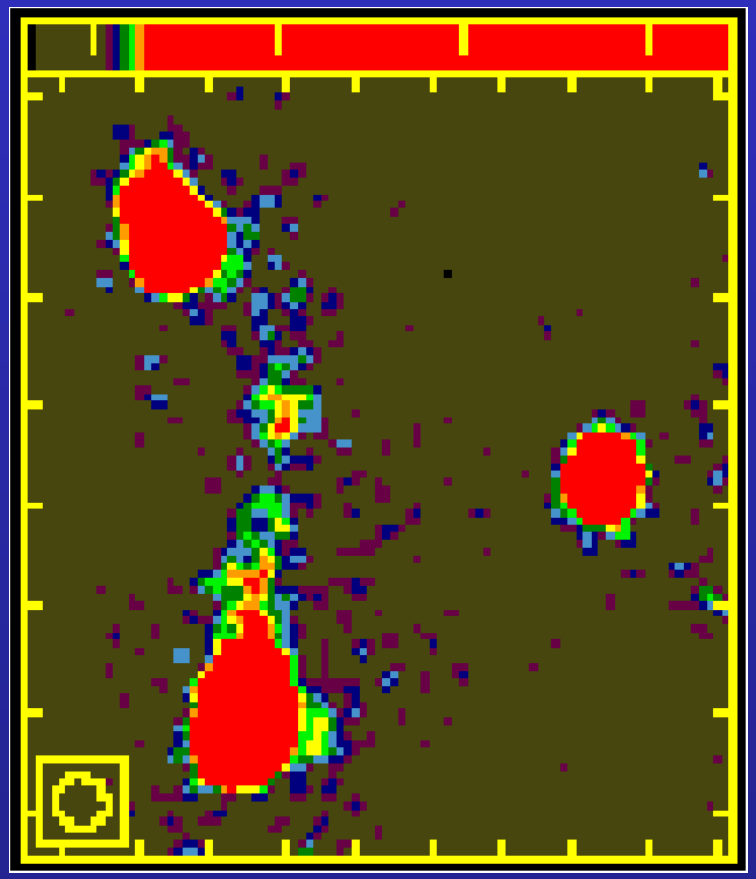
- The spectrum showed a small but significant amount of flux between the two main spectral peaks at around -44.5 kms^{-1}.





- Using a larger (100 × 100 mas) synthesised beam we detected this flux in the form of a large-scale OH 4765-MHz maser filament extending 1 arcsec (2200 AU) between spots A and B.

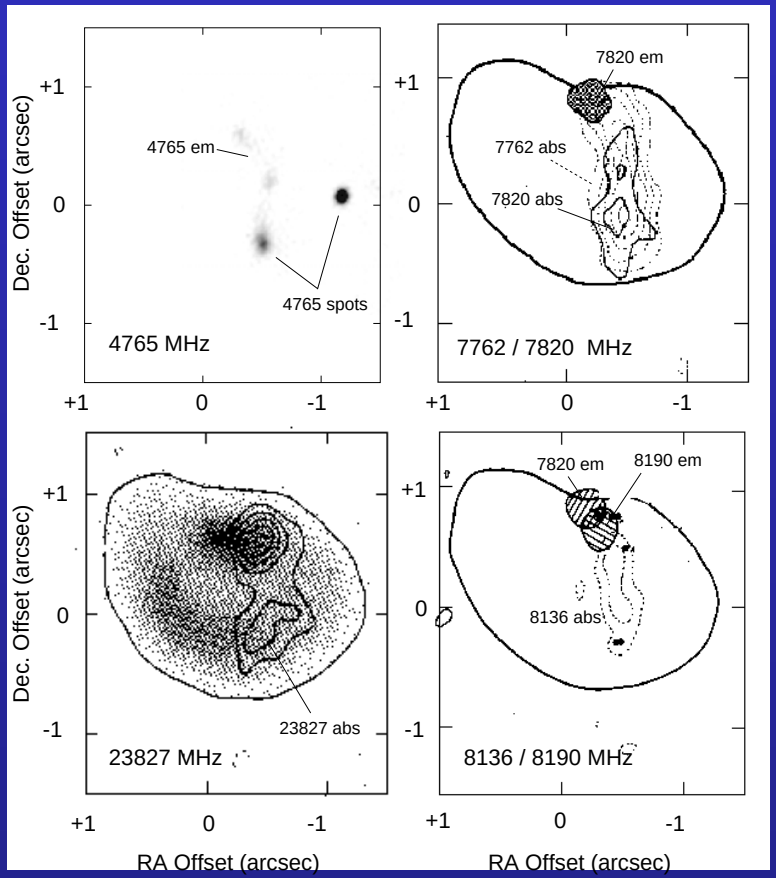
MERLIN Results



- Colour image of OH 4765-MHz emission integrated between -44.0 and -44.8 kms^{-1}.
- Maser spots A, B and C are clearly visible, as is the filament of extended emission stretching between spots A and B.
- We detected weak haloes around all three spots, suggesting that they may also be filamentary in nature. The OH 4765-MHz filament was found to have a velocity gradient, from -45 km/s in the North to -44.3 kms^{-1} in the South.

Discussion

- The OH filament also appears to be embedded within extended 4750-MHz quasi-thermal emission and 4660-MHz absorption detected by Guilloteau et al. (1985).



Summary

- Multi-frequency studies of OH masers can lead to an understanding of the physical conditions in massive SFRs.
- We are undertaking surveys in several transitions of OH and methanol.
- We have found a unique large-scale 'filament' of extended OH emission at 4765 MHz. This is interpreted as tracing a large-scale shock in W3(OH).
- Maser co-propagation studies are on-going.

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MERLIN